Composite processing through extrusion based additive manufacturing

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Introduction

The application of additive manufacturing has revolutionary increased during the last 25 years. One of the most used additive manufacturing (AM) techniques is extrusion based, often referred to as Fused Deposition Modeling (FDM). Despite its popularity, some shortcomings are to be solved. In this study, current limitations of extrusion based processes will be discussed. Further, a brief overview of different composite materials which can enhance mechanical, thermal, electrical, etc. properties will be given. Finally, an innovative building strategy for increasing manufacturing speed and dimensional accuracy is proposed.

Current limitations of FDM

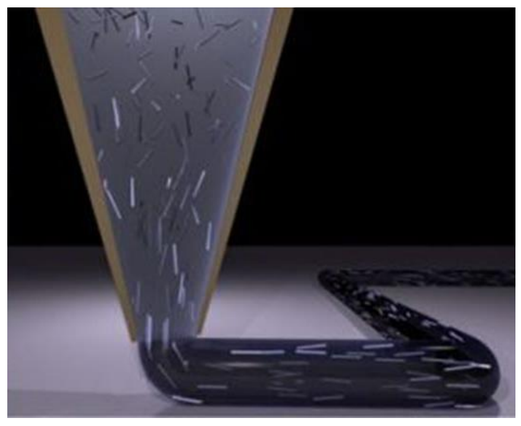
- Anisotropy between layers due to additive process
- Intermediate mechanical properties
- Limited dimensional accuracy (stair-case effect)
- Low material deposition speed
- Poor interlayer bonding
- Warpage and thermal stresses

Composite materials for AM

Particle filled polymers for enhanced stiffness, wear resistance, thermal and electric properties.

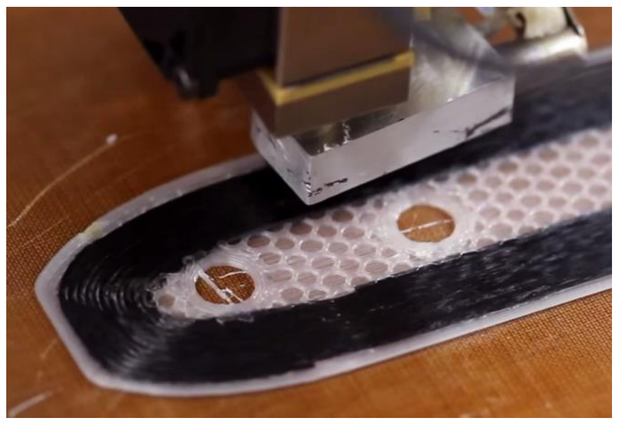
[1]

Short fibre filled polymers for higher stiffness and wear resistance.



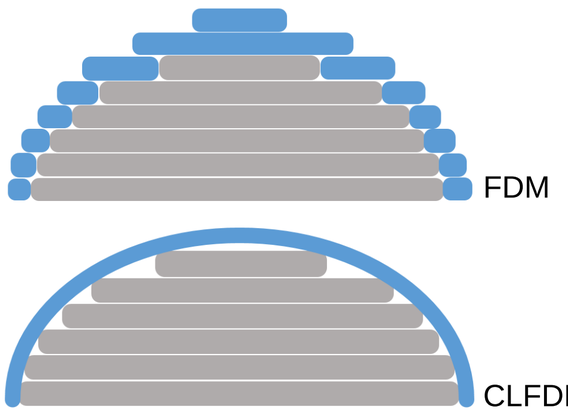
[2]

Continuous fibre composite for higher stiffness, tensile and impact strength.

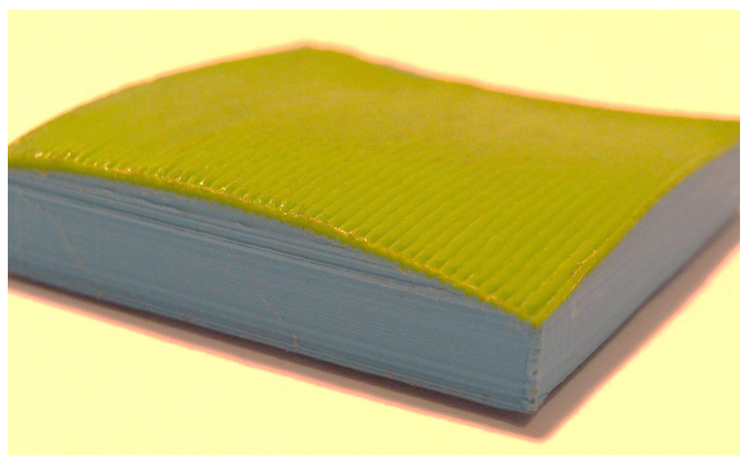


[3]

Curved Layer AM



- Deposition normal to a surface
- Better surface quality
- Anisotropy can be used as an advantage
- Faster printing of curved surfaces
- Printing on existing objects
- Parallel research at Auckland University of Technology



Future research

In future research, the development of a custom made printing head will be necessary for processing and analysing new (composite) materials for additive manufacturing. Existing printing machines will have to be adapted to give the printhead the desired degrees of freedom.

[1]: Nikzad, M., S. H. Masood, and I. Sbarski, 2011, Thermo-mechanical properties of a highly filled polymeric composites for Fused Deposition Modeling, Materials & Design, v. 32, p. 3448-3456

[2]: Ozkoc, G., G. Bayram, and E. Bayramli, 2005, Short glass fiber reinforced ABS and ABS/PA6 composites: Processing and characterization: Polymer Composites, v. 26, p. 745-755

[3]: Markforg3D, Mark One, carbon fibre sample